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The Resources of Pennsylvania at a Glance

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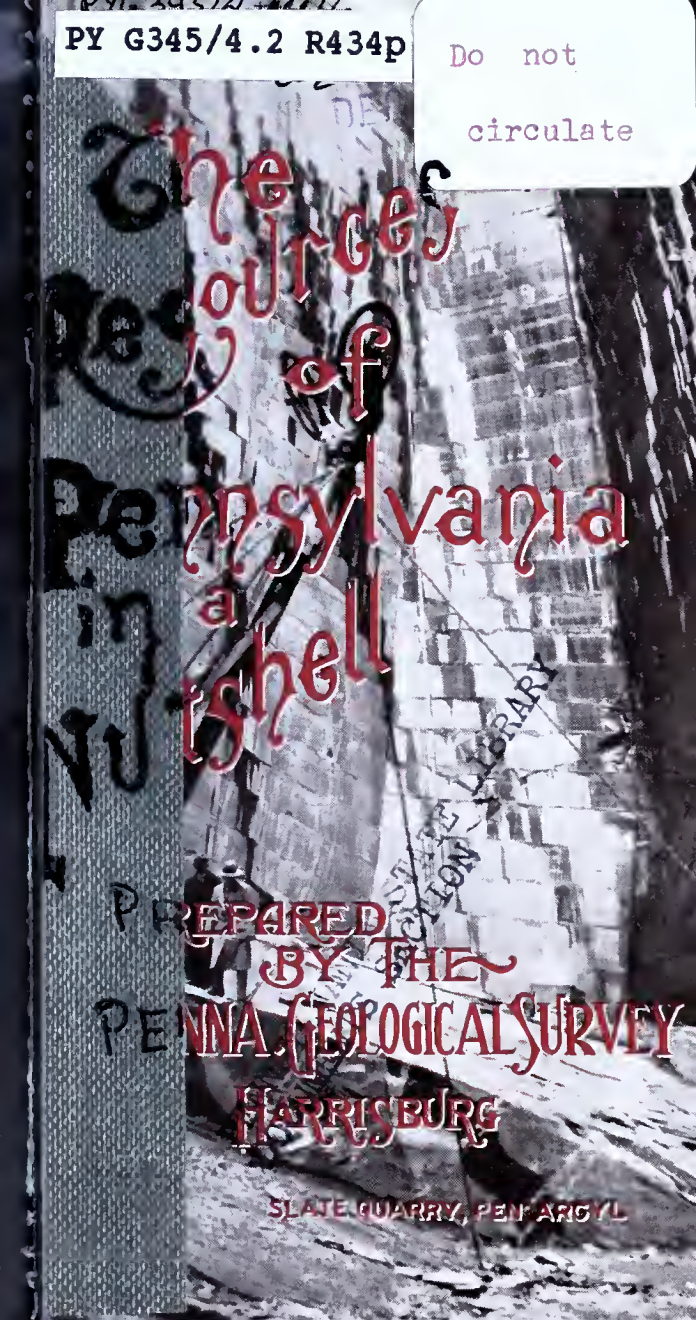


SLATE QUARRY, PEN ARGYL

Misc. Paper #4

In mining and metallurgy Pennsylvania is the peer of any country in the world. (Rosedale by-product Coke plant, Rosedale, Cambria County.)

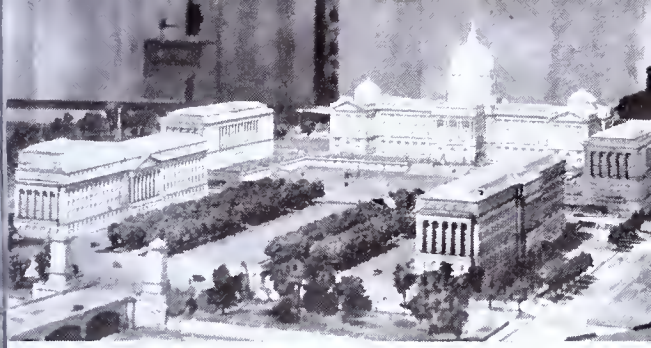
THIS folder has been prepared as a vest-pocket reminder, an epitome of the State, in the belief that every patriotic and intelligent citizen of Pennsylvania should know the main facts about her resources.

Pennsylvania, though only 32nd among the States of the Union in size, is 2d—in population, wealth and productive industry, and first—in mining, in 42 leading manufactured products, in power production, and in many other ways.

The Topographic and Geologic Survey, Department of Internal Affairs, is the State's official organization for making a topographic and geologic map of Pennsylvania and for mapping, studying, testing and describing the rocks and mineral resources, soils, and underground waters.

Our motto is, "It pays to know, ask us."
The Survey's publications are listed beyond.

GEORGE H. ASHLEY,
STATE GEOLOGIST



Model of State Capitol buildings at Harrisburg.

THE RESOURCES OF PENNSYLVANIA IN A NUTSHELL

General

Area ~~44,832~~ 45,382 sq. mi. Population, (1930) 9,638,698. Property assessed at (1926) $11,599,721,535. Bonded debt: State, (1928) $93,379,320; local, (1926) $838,035,590. State's income (1928) $168,965,701. Local taxes levied (1926) $321,937,872. Some State appropriations (1929-1931), Health $4,956,000, Highways $144,917,373, Public Instruction $89,323,000, Welfare $43,736,551, Property and Supplies $18,383,523.

Pupils in schools, 1,849,163.

School property, value, $449,747,344.

Productive industries, value, $7,789,603,200.

Mined products, value, (U. S. G. S.) $1,055,766,077.

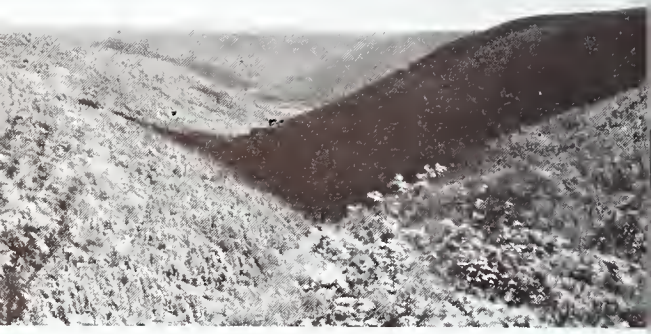
Farm products, value, (Dept. of Agri.) $375,731,000.

Public utilities, receipts, $2,132,580,315.

Productive industries, capital, $5,479,109,600.

Steam railways, capital, $1,514,491,800.

Other public service, capital, $3,852,773,821.



Plateau of Northern Pennsylvania, Potter County.
Courtesy of Highway Dept.

Description of State, southeast to northwest.

(1) Coastal Plain province. Low lying belt along Delaware. Truck gardens, factories, sand and gravel. *(2) Piedmont upland.* Plateau 400 to 1,100 ft. A. T., narrow, deep valleys. Cultivation slight. Home sites. Building stone, minerals. *(3) Chester, Lancaster, York valleys.* Rolling surface. Limestone, iron. Rich farm lands. *(4) Triassic redlands.* Rolling and hill lands. Farms. Trap rock, iron ore, brownstone. *(5) South Mountain.* Mountains 1,000 to 2,000 ft. A. T. Camp sites, hunting, health resorts. Some rock values. *(6) Kittatinny Trench.* (Lehigh, Lebanon, Cumberland valleys.) South side limestone; north side shale, slate and sandstone. Rich farm lands, fruit, limestone, cement, slate, iron, zinc. *(7) Vallemont region.* Broad, rolling valleys 400 to 1,200 ft. A. T., and narrow, steep-sided, even-crested mountain ridges, 1,300 to 2,500 ft. A. T. Limestone, iron, ganister, glass sand. Anthracite at northeast. *(8) Allegheny plateaus.* High plateaus in north and central Pa.; deep, narrow, valleys, 3,200 ft. A. T., declining to 1,250 ft. near Pittsburgh. Coal, oil, gas, clay, limestone, sandstone, iron, timber, farms. *(8a)* Glaciated.

Pennsylvania leads world in iron, cement, glass, etc. Typical view in Pittsburgh district.

Pennsylvania's "Place in the Sun."

Pennsylvania's position is due mainly to the initiative and industry of her people. She has led in art and music, science and letters, government and war, but especially in mining and metallurgy. In 1830 she mined 99.03% of the coal, and 50% of the iron mined in the United States. Even 50 years ago she mined 66% of the nation's coal, though possessing only 3.7%. To 1920 she had mined 6,690 million tons, rest of States 6,672 million tons. The oil and gas industry began in Pennsylvania, which for 30 years produced more than one-half of the total.

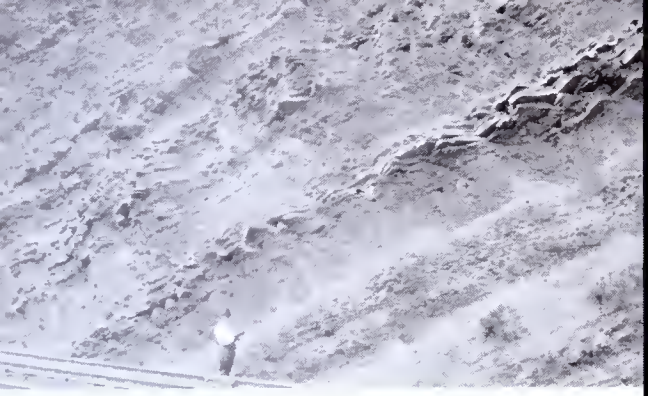
In 1927 Pennsylvania still stood first in production value of: Cement, raw clay, coal, coke, ferroalloys, pig iron, mineral paints, slate; second in briquettes (fuel), clay products, lime, sand and gravel, silica sand, stone; and third in natural gas, sulphuric acid from copper and zinc smelters.

At present, Pennsylvania produces about one-seventh of the world's coal supply; more pig iron than any other state or nation, one-tenth of the world's supply of cement. Estimated value, mineral production (1923) (millions of dollars) Pennsylvania, 1,226; Great Britain, 1,158; Germany, 1,000; France, 800.

Rocks deposited in sea 300,000,000 years ago, folded 200,000,000 years ago. Juniata River near mouth.

Geology of Pennsylvania.

The geologic high points: (1) Pennsylvania lying below sea level, receiving sediments mainly from southeast. Sea bottom sinks, with occasional uplift, until 30,000 to 40,000 feet of sediments have been deposited, including present mineral resources. Time: Pre-Cambrian to Carboniferous. (2) Crustal folding, pressure from southeast, shortens State 100 to 200 miles, rock folds—if restored—30,000 feet high or more. Folding intense at east, dies out toward west. High-volatile coal changed to anthracite at east. Oil and gas distilled out of eastern rocks. State resembles Andes or Himalayas. (3) Long period of erosion (Mesozoic era). Rock folds worn down to a plain. Interrupted in Triassic time by crustal breaking, sinking, sedimentation and huge upflows of trap rock. (4) Slow uplift with pauses. Old plain preserved in level mountain crests on hard rocks. Soft rocks worn down into valleys. (5) Ice invasion of northern corners of State. Glacial deposits, lakes and waterfalls there.



50,000 feet of rock laid down in Pennsylvania. Measuring upturned strata on Horseshoe Curve.

A Stratigraphic Table of Pennsylvania's rocks.

(ss = sandstone; sh = shale; ls = limestone; dol = dolomite; sl = slate; qtz = quartzite)

Cenozoic era: (Age of Mammals) 60 mil. years.
Quaternary: river and glacial deposits, 150 ft.
Tertiary: hilltop deposits, SE.; erosion in Pa.

Mesozoic era: (Age of Reptiles) 150 mil. years.
Cretaceous: (Age of Chalk) erosion, no rocks.
Jurassic: erosion, no rocks.
Triassic: red sh. and ss.; 20,000 ft. in SE. Pa.; trap rock.

Time of major rock folding.

Paleozoic era: Sedimentation, 400 mil. years.
Carboniferous: Upper and Middle, Coal Measures, 3,500 ft. coal, clay, ss., ls.
Lower, 3,000 ft., oil, gas, ss., sh., ls.
Devonian: (Age of Fish) sh., ss., ls.; 10,000 ft.
Silurian: red sh., qtz., iron; 4,000 ft.
Ordovician: sh., sl., ls., cement, lime, iron, 4,000 ft.
Canadian: dol., ls.; 1,500-7,000 ft.
Cambrian: dol., ls., ss., iron; 2,000-10,000 ft.

Proterozoic era: Pre-Cambrian, Fossils destroyed.
Algonkian: sl., schists, marble, qtz.; 10,000 ft.
Igneous rocks, granites, gabbro, etc.
Archean: granite, gneiss. No life?

Coal ready to go to market. "Pennsylvania so far exceeds all the rest of the States in the value of its mineral products as to stand almost alone." (U. S. Government report.)

Mineral Resources. (1926)

Product	Quantity	Value
Briquettes, fuel --short tons	163,707	$1,102,835[1]
Cement ----------barrels	41,395,604	70,437,218
Clay products ----------	----------	55,041,270
Clay, raw --------short tons	855,832	2,563,374[1]
Coal:		
Anthracite ----------do	84,437,452	474,164,252
Bituminous ---------do	153,041,638	325,618,000
Coke ----------do	21,922,976	96,318,119[1]
Copper ----------pounds	1,018,536	142,595
Feldspar (crude) --long tons	1,484	4,492
Ferro-alloys ----------do	376,301	35,975,381[1]
Gold ----------troy ounces	22	450
Iron ore:		
Sold to furnaces -long tons	1,088,634	2,483,056
Sold for paint -------do	2,215	(2)
Iron, pig ----------do	13,142,528	263,238,184[1]
Lime ----------short tons	794,196	6,303,312
Natural gas ---M cubic feet	107,089,000	50,404,000
Natural gasoline ----gallons	20,343,000	2,454,000
Petroleum ----------barrels	8,961,000	31,930,000
Sand and gravel --short tons	12,873,953	11,695,218
Silver ----------troy ounces	544	339
Slate ----------	----------	5,413,177
Stone ----------short tons	16,628,770	19,157,336
Sulphuric acid (60° Baume') --------do	153,513	1,447,000[1]
Miscellaneous[2] ----------	----------	14,064,462
Total value, eliminating duplications ----------	----------	1,055,766,077

[1] Value not included in total value for State.

[2] Includes gems and precious stones, iron ore for paint, mineral paints, mineral waters, peat, potassium salts, ground sand and sandstone, sand-lime brick, silica, talc, rottenstone.

Photo Courtesy of Delaware and Hudson R. R.

Pennsylvania mines nearly 1/7 of the world's coal supply. A modern anthracite breaker and washery.

Coal. Anthracite fields 484 sq. miles. Bituminous fields 14,200 sq. miles. Anthracite, 16 principal beds, thickness, (max.) up to 114 ft.; all beds, Southern field (aver.) 143 ft. 7 ins. coal remaining (est.) 16,350 million long tons, recoverable (est.) 8,900 million long tons. Bituminous, 74 beds; 10 principal beds. Thickness 16 ft. to 2 ft. or less. Pittsburgh bed about 7 ft. Original deposit, (est.) 76 billion short tons; mined out and lost, 5,800 million short tons; recoverable, 44,700 million short tons. The largest bodies of unmined coal in (billion tons) Greene, 6.3; Washington, 5.4; Indiana, 4.3; Somerset, 3.9; Cambria, 3.6; Westmoreland, 3.2.

The anthracite beds commonly highly folded, locally crushed and broken. Mining on pitching to nearly vertical beds to depth of about 2,000 ft. Raise 12 tons of water to ton of coal. Average recovery 65.4 per cent, from 53.8 in Southern field to 73.7 in Eastern Middle field (1921); formerly much less. Total anthracite produced (1807-1925), 3,478,458,909 short tons. Bituminous beds, nearly flat lying; most mines under 500 ft. deep. Recovery (aver.) 71.4 per cent (1923). Total production (1840-1925) 4,549,147,753 short tons.

Pennsylvania led the way to the modern use of oil. Gas pool near Wilkinsburg.

Oil and gas. Confined to western counties. Industry started in Pennsylvania, 1859. Pennsylvania led until 1895. Total production of oil (1859-1925) 788,366,000 bbls. Maximum production 1891 (31,424,000 bbls.). Production declined until 1921 (7,418,000). Now on increase (1929) 11,805,000 bbls. Natural gas extensively used since 1882. In 1906 produced 138 billion cu. ft.; in 1927 produced 105 billion cu. ft. valued at $49,135,000, and consumed much more.

Oil and gas of Pennsylvania come mainly from Lower Carboniferous and Upper Devonian sandstones ("sands"), at many horizons. Total number of wells: oil 80,000; gas 50,000; deepest well 8,100 ft. Several wells over 7,000 ft. deep. Oil occurs in narrow belt, usually at depths less than 3,000 ft.

Pennsylvania's increased oil production is result of driving out oil, left after first recovery, by water, air or gas under pressure. Successful in Bradford field. May not be over fields in general. The total producing area in Pennsylvania, 380,000 acres. Estimated future recovery by drilling, 650 million bbls.; left in ground 700 million bbls., much of which may be recovered by mining and distilling. Gas reserve: 3 trillion cu. ft.

Pennsylvania leads in production of clay, and stone, Sandstone quarry, Beaver Valley.

Clay and related products. Pennsylvania produces about ⅛ of clay products of U. S. (value), ranking first (without pottery). Clays principally from coal counties. (Values for 1923) (1) Fire clay and fire brick; use flint clay, mixed with soft clay; under bit. coal beds; $19,208,240 (2) kaolin and white clays; small deposits in southeast counties and Nittany Valley; (3) other pottery clays, mainly for sanitary and electrical use; total "pottery" $7,852,092; (4) brick, tile and terra-cotta; use subcoal clays, ground shales, alluvial muds, widely distributed; $27,500,000; (5) silica brick, from ground quartzite, over $9,000,000; (6) magnesia and magnesia brick, from calcined dolomite, $2,700,000. Total, including raw clay and pottery, $73,352,911.

Sand, gravel and sandstone. Sand and gravel from river valleys and channels, and glacial outwash. Much sand from crushed sandstone. State leads in total production; value, (1927) including glass sand, molding sand, etc., $12,040,406. Sandstone quarried for building, paving, curbing, etc., and for roads, concrete and railroad ballast. Flagstone industry in northeast counties. Total value sandstone, cut or broken (1926) $2,625,730.

Pennsylvania produces 1/4 of nation's cement supply. Limestone quarry and lime plant, York.

Limestone, lime and cement rock. The limestones of Pennsylvania include: (1) Cambro-Ordovician limestones and dolomites, 6,000-10,000 ft. thick, underlie central and eastern valleys. Chemical lime from thin, pure limestones. Dolomites used in iron industry. At top, grades into shale, source of cement industry of Lehigh Valley; (2) a limestone 100-300 ft. thick (Helderberg), central Pennsylvania. Local building stone; (3) limestones in Coal Measures, especially the Vanport, Beaver to Jefferson Counties, 0-20 ft. thick, much used for ballast, lime, flux and cement.

Production (1926) see table page 8; limestone for concrete and roads, 3,830,210 tons; flux, 8,694,810 tons. Marl, small, calcareous, surface deposits.

Granite and related building stones. Granite, gneiss and schist in Piedmont upland, and gabbro and diorite in South Mountains of Berks and Lehigh Counties. Much used locally. Granite occurs only locally. Extensively used. Production (1925) 308,930 tons, value $812,810. Trap, (diabase, basalt) and rhyolite, igneous rocks, mostly Triassic, abundant in "red beds" area, and in South Mountains.

Pennsylvania has the eleventh largest iron mine in U. S. Mining iron ore at Cornwall, Lebanon County.

Trap, quarried for road building and as "black granite." Green and red rhyolite ground for roofing granules. Production (1926) 1,472,930 tons, value $2,068,773.

Slate. Extensively quarried in Lehigh and Northampton Counties and a little in York and Lancaster Counties. Quarries 500 feet deep or more. Pennsylvania leads.

Metallic minerals. Iron. Pennsylvania's iron production started in colonial days from brown iron ores occurring mainly with limestones, and in the Coal Measures. Carbonate ore is mined locally for paint. Iron ore mining today confined to magnetite, at Cornwall. *Copper.* Lean ores found in South Mountain and elsewhere. Not mined. 500 tons recovered annually from Cornwall iron ore. *Pyrite, marcasite and tungsten* found as specimens. Pyrite recovered locally in coal mining. *Lead and zinc.* Lead formerly mined in Chester and Blair Counties. Zinc was extensively mined in Lehigh County. *Aluminum minerals,* as mineral specimens. High alumina clay in coal fields. *Manganese,* widely scattered. Has been mined locally. *Chromite* formerly mined extensively in southern Lancaster County. *Nickel* once mined in Lancaster County. *Cobalt*

Pennsylvania leads in the production of mineral paints. Talc mine, Easton. Used for paint, etc.

minerals in Chester and other counties. *Gold and silver.* As secondary minerals from Cornwall magnetite. *Radium,* traces of carnotite near Mauch Chunk. *Mineral paints.* Ochers and other ores and rocks mined on small scale for mineral paints and mortar colors.

Nonmetallic minerals. Serpentine, in belt, Delta to Easton; building stone and interior decoration. *Talc,* with serpentine; varied uses; production (1924) 8,281 tons, value $83,296. *Salt, bromine and iodine.* Formerly obtained from wells along Allegheny River. Rock salt in Upper Silurian rocks at depth. *Graphite,* flakes in gneiss, formerly mined in S. E. counties. *Phosphate minerals.* Known in Cumberland and Juniata Counties. *Asbestos,* found in Delaware and other counties. *Magnesia.* From calcined dolomite; value (1921) $2,294,700. *Barite,* formerly mined on small scale in several counties. *Feldspar,* in pegmatite dikes in Delaware and Chester Counties; production (1920) 8,562 tons; value $81,104. *Mica,* widespread, not in commercial quantity. *Vein quartz,* small quantities produced in S. E. counties. Specimens of other minerals found, but not in commercial quantity, include beryl, flourite, garnet, greenockite, celestite, rutile, strontianite, tourmaline and zircon.

Pennsylvania Geologic Survey Publications.

The following are out of print but can be consulted in most public libraries, except (a):

Miscellaneous Papers

1 The Story of the Survey, Ashley, 20 pp.
2 The Work of the Survey, Ashley, 18 pp.

Bulletins and County Reports

M1 Oil and Gas Fields of Pa., Ashley, Robinson, 79 pp.
M2 Oil in Coals and Carb. Shale, Fettke, 119 pp.
M3 Silica Refractories, Moore, Taylor, 100 pp.
M4 Bituminous Coal Losses, etc., Sisler, 261 pp.
M5 Lead and Zinc Ores of Pa., Miller, 91 pp.
M6 Coal Fields of Pa., Pt. II, Sisler, 511 pp. (a)
M7 Limestones of Pa., Miller, 368 pp.
M8 Anthracite Losses and Reserves in Pa., Ashmead, 71 pp.
M9 Slate Deposits of Northampton County, Behre, 312 pp.
A37 Greensburg Atlas, Johnson, 162 pp.
A178 New Holland Atlas, Jonas and Stose, 40 pp.
C1 Adams County Reports, Pts. II and III, pp. 64 and 44 (a).

The following reports can be obtained on request from this Survey.

G3 Pennsylvania Caves, Stone, 63 pp.
M10 Fire Clays of Pa., Shaw, 69 pp.
M11 Molding Sands of Pa., Stone, 94 pp.
A65 Punxsutawney Atlas, Ashley, 145 pp.
A206 Allentown Atlas, Miller, 195 pp.

The following can be obtained only from the Bureau of Publications, Department of Property and Supplies, Harrisburg, at the prices quoted, prepaid.

M6 Bit. Coal Fields of Pa., Pt. I, Ashley, 241 pp., 50 cts.
M6 Bit. Coal Resources, Pt. III, Reese, Sisler, 153 pp., 25 cts.
M6 Bit. Coal Analyses, Pt. IV, 268 pp., 25 cts.
M12 Anthracite Culm and Silt, Sisler, Frazier, Ashmead, 268 pp., 50 cts.
A5 New Castle Atlas, De Wolf, 238 pp., $1.00.
A27 Pittsburgh Atlas, Johnson, 236 pp., $1.00.
A168 Lancaster Atlas, Jonas and Stose, 108 pp., $1.00.

Typical view—Vallemont region,—valley and ridges, controlled by hardness of rocks.

Other Publications on Pennsylvania Geology.

The U. S. Geological Survey, (address The Director) Washington, D. C., has published topographic maps covering three-fourths of Pennsylvania. These can be obtained from that Survey for 10 cts. each. (Send for key map). That Survey has also published over 30 geologic folios of quadrangles. Most of these are out of print. But folios of the following can be obtained from The Director at prices quoted: Gaines, Claysville, 5 cts. each; Barnesboro-Patton, 25 cts.; Fairfield-Gettysburg, 50 cts.; Economic geology bulletins can be obtained from Supt. of Documents, Washington, D. C., as: Kittanning-Rural Valley, No. 279, 50 cts.; Elders Ridge, No. 256, 15 cts.; Beaver, No. 286, 35 cts.; Amity, No. 300, 30 cts.; Johnstown, No. 447, 25 cts.; Foxburg, No. 454, 30 cts.; McCalls Ferry - Quarryville, No. 799, 35 cts. Many other U. S. G. S. bulletins refer to Pennsylvania. Get list from The Director. In addition to these, principal libraries have over 100 volumes issued by the Second Geological Survey of Pennsylvania; several volumes issued by the Rogers Survey, and 19 volumes issued by the Topographic and Geologic Survey Commission of Pennsylvania. These are all out of print. First and Second Survey reports can be purchased from second-hand book dealers.